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# SITUATION AT LITTLE FALLS, NEW JERSEY

By F. W. Green

The difficulties that arise at any given filtration works depend upon the character of the natural water to be treated, both as to its mineral and organic constituents. The Passaic River at Little Falls, New Jersey, is a rather highly colored surface water, comparatively free from contamination and of medium hardness for this section. It presents the usual problems of a water of this class: namely, intermittent occurrences of red water troubles, difficulty of coagulation and low organic matter after filtration. This latter in turns means delicacy of chlorine reaction.

Fortunately, these conditions are by no means continuous and therefore the filters can generally turn out a product that is perfectly satisfactory in every respect. The aim is to maintain the output at the highest degree of perfection at all times, from an esthetic as well as a hygienic standpoint, and the author wishes to present to you some of the more recent developments for this purpose that have been tried, or are about to be tried at the Little Falls plant.

The first subject for consideration will be red water. There are several theories to account for the phenomenon called red water. At present the experiments at Little Falls are based on the free carbonic acid theory. The writer wishes to advance the theory that free carbonic acid may exist in the water in two conditions; not only may there be free carbonic acid existing in a water supply in the dissolved state, but also in what may be called the entrained state. The quantity of free carbonic acid which water can dissolve depends upon both the temperature of the water and the pressure to which it is subjected. At atmospheric pressure, and a temperature slightly above freezing, water can absorb about fifteen parts per million of free carbonic acid. During the colder months of the year water of this temperature is often handled that is saturated or nearly so with free carbonic acid. When, on passing through the pump, such a water is subjected to a greatly increased pressure, it be-comes supersaturated as regards the carbonic acid content, and the excess exists, as small bubbles of the gas, in what has been termed by the author the entrained state. An increase in the temperature of the water merely exaggerates the case, so that red water is most frequently a hot water trouble.

The present method of attack at Little Falls is the addition of lime by means of two helicoid conveyors, and also a system of electrolizing the water by means of a low density current is being worked out, the gas being gathered as bubbles on a specially designed cathode, and then removed by a process which will be patented when perfected, and therefore can not be given in detail at present. In both cases only sufficient carbonic acid will be removed to leave a residual content of say ten parts per million.

Difficulty of coagulation occurs at widely separated intervals, and gives rise to flocculant hydrate in the effluent. At times it requires a considerable period of time after filtration for these flocs to gather, and the writer feels confident that in many of the smaller plants their presence would be noted much more frequently were it not for the fact that the water has been consumed before there has been time for them to settle out.

The first experience of hydrate in the effluent occurred in 1902, soon after the plant was put into operation, and it is still occasionally encountered. At times a heavy floc occurs in our sedimentation basin, but it is so delicate in construction that it is entirely broken up before it reaches the filter beds. It is hoped that our new 5,000,000-gallon coagulation basin will enable us to become better acquainted with the causes that lead to this condition. This problem is more or less intimately connected with abnormal conditions of the "oxygen consumed" content.

The "oxygen consumed" content has undergone violent fluctuation at all the plants in the vicinity during the past two years, due to crude oil (fuel oil) treatment by the Mosquito Extermination Commission of the ditches and pools of the meadows and other low lying parts of the watershed. All stagnate water has been coated with a film of fuel oil in order to prevent the growth of the incipient mosquito. After a rain the oil is washed over the meadows, thereby killing the grass or hay and extracting its coloring and other organic properties and leaving the grass dead and brittle, and bleached to a grayish white. The amount of color in the water has been higher this past year than ever before, and the shade of the water was a brownish tan, entirely different from any normal water. Later on the action causes low "oxygen consumed" and difficulty of coagulation, or rather fragility of the aluminum hydrate floc.

Low oxygen consumed also necessitates greater care in the application of the sterilizing agent. Under normal conditions any slight excess of chlorine is taken care of by the organic matter that is present in the water, but when the oxygen consumed is low, extreme care is required to introduce a quantity of the sterilizing agent sufficient to eliminate the B. coli and practically all of the harmless bacteria, and at the same time steer clear of the tastes or odors due to overdosage. While realizing that sodium thiosulphate will absorb the excess of chlorine that may be added under these circumstances, there is extreme reluctance about applying an additional chemical.

In conclusion the writer wishes to call particular attention to the present status of the method by which the sterilizing agent is introduced into the water. At most plants where an agent is applied chlorine is used in one or the other of two forms. This chemical was first used in the form of bleach, and it was gladly welcomed, for the reduction of coagulant and the marvelous residual bacterial content which it made possible, far outweighed its unpleasant features. Then came liquid chlorine to relieve many of these disagreeable features. The chlorine was confined in a strong steel cylinder. The contents were all chlorine and went directly from the tank through the regulating apparatus and the absorption device into the supply, but it is more expensive. There is at times, many hours' supply ready and anxious to escape into the water, and even a 10 per cent additional dose would be very undesirable. A thin diaphragm is depended upon to prevent such a calamity; also there have been times, even at plants where the average amount of intelligence has been bestowed upon the handling of the chlorine, when a cylinder of liquid chlorine has been known to escape into the atmosphere with unpleasant results. The writer does not speak from personal experience, but does not feel assured of safety from a similar experience, in spite of oft repeated warnings on his part, upon the subject. Slight leaks are of frequent occurrence, and a certain amount of the chlorine is necessarily liberated each time an empty cylinder is disconnected from the measuring apparatus.

The reason for having had to use either the bleach or liquid chlorine is purely one of transportation. Chlorine under normal conditions is a gas, and has been manufactured at a point distant from its place of application. In order to transport it, it was necessary to absorb it by means of some suitable medium, and from a commercial standpoint lime was the most satisfactory material to use. By passing the gas over lime, bleach, or bleaching powder, is secured, but this is a rather unstable product that is made up of a mixture of calcium chloride and calcium hypochlorite. It is strongly deliquescent, and after absorbing water attacks iron, of which most of our domestic containers are made, very actively. Finally, half of the chlorine is combined so securely that it is no longer available and so it is lost forever. Bleach has been added as a milk, in which case the solution tanks should be constantly stirred, or the solution has been allowed to settle and only the supernatent fluid drawn off for use; each system has its drawbacks, but it is the cheaper and safer method.

Liquid chlorine is much nicer to handle when everything goes well, as it usually does, but it is somewhat more expensive. The cost of manufacturing the chlorine gas is reasonable enough but to prepare it for shipment it must be purified, dried and liquefied. If made by the hot process cell it must be cooled before this is done, and it must be compressed to a liquid with further cooling. The containers in which it is shipped must conform to very strict rules as specified by the government, and the valves and the caps of the cylinders must be very carefully gone over each time they are returned to the factory. All of this adds to the expense, and when a sudden foreign demand occurs to drain the country of both the gas and containers, which are left on the battle field, the price soars still higher.

The answer to these problems appears to be for the larger filtration works to purchase their chlorine as common salt, sodium chloride, and manufacture their own chlorine gas by the process in use at the factories. Rock salt is worth in New York City less than $5 a ton, and a ton will supply a 20,000,000 gallon per day plant for a month. The gas could be taken directly from the electrolytic battery and applied to the supply. The cold process cell could be used and all the drying, cooling, purifying, compressing and transporting charges would be eliminated.

Small plants should use bleach, liberating both the available and unavailable chlorine by means of crude sulphuric acid, and applying same as a gas. This has been done by the writer in the laboratory and appears to be the ideal way. Combined with suitable containers, say of earthenware or glass, for the storage of the bleach, it is a far superior process to the present crude method. At present it would appear that works handling 5,000,000 gallons of water a day should install their own chlorine factories and those smaller than this should release the Cl from the bleach and apply it as a gas; in both cases getting it in a nascent state and using it in the most advantageous, safe and agreeable manner.

## *DISCUSSION*

**Mr. George A. Johnson**: Mr. Green's closing remarks in reference to hypochlorite of soda manufactured on the ground recall to the speaker some very interesting facts which were considered long ago. If, when bleaching powder first came into use, as much had been known about the electrolytically produced hypochlorite as is now known, bleaching powder would have had a hard time getting the hold it has.

The process of making hypochlorite of soda electrolytically is a simple one, and where electric current costs about 1 cent per kilowatt hour, and where common salt may be had for $\frac{1}{4}$ cent per pound, hypochlorite may be produced for practically the same price as bleaching powder costs when the market is normal, basing such costs on a unit of available chlorine.

It will be of interest if Mr. Green will tell us if, with the use of the large quantities of fuel oil on the watershed, for the extermination of mosquitoes, trouble has ever been experienced from tastes produced by the oil so used.

**Mr. F. W. Green**: There is a slight oil scum on the water once in a while. This oil is put in the ditches below the surface of the surrounding meadows and lies there without doing harm until a rainstorm comes. Then a part of it appears to attack the grass and vegetable matter and part of it comes down as a scum. It is all taken out and left in the filters, but more or less trouble from clogging of the filters is anticipated.

With the chlorine process we have investigated both the manufacture of sodium hypochlorite and chlorine as a gas, and find the latter is much better to use and less liable to cause tastes and odors. There is nothing added to the water except the chlorine, which is the part that is desired.